AMENDMENT TO THE CLAIMS

Claims 1-24 (Cancelled)

25.(New) A component mounting apparatus including:

an X-Y robot that has a component placing head provided with a component holding member for holding an electronic component, for mounting the electronic component held by the component holding member in a component placing position of a circuit board by moving the component placing head in an X-axis direction and a Y-axis direction that are perpendicular to each other;

a board recognition camera that is provided on the component placing head, for picking up an image of a board mark on the circuit board;

a component recognition camera for picking up an image of the electronic component held by the component holding member; and

a control unit for controlling the X-Y robot, the board recognition camera, and the component recognition camera;

the apparatus comprising:

a camera reference mark arranged adjacent to the component recognition camera in a place where the image-pickup of the electronic component by the component recognition camera is not disturbed; and

a chassis on which the X-Y robot, the camera reference mark, and the component recognition camera are individually arranged upright, wherein

the camera reference mark is arranged at the same height position as that of the circuit board when the board recognition camera picks-up the image of the board mark and an image-pickup height position of the component recognition camera,

the control unit obtains relative positional relations among the component holding member, the board recognition camera, and the component recognition camera from center position information of the component holding member obtained by image-picking up the component holding member by means of the component recognition camera and image information obtained by image-picking up an image-pickup mark provided at the image-pickup height position of the component recognition camera by means of the component recognition camera and the board recognition camera,

an amount of displacement of a positional relation between the component holding member and the board recognition camera among the relative positional relations is ignored with regard to an amount of displacement attributed to heat,

the displacement information of the camera reference mark obtained by image-picking up the camera reference mark by means of the board

recognition camera is used as information of a relative displacement between the board recognition camera and the component recognition camera, and the component placing position is corrected based on only the displacement information.

26.(New) The component mounting apparatus as claimed in claim 25, further comprising an integrally structured component mounting apparatus chassis, wherein

the X-Y robot comprises two identical Y-axis robots arranged mutually parallel along the Y-axis direction and one X-axis robot arranged along the X-axis direction perpendicular to the Y-axis robots, each of the Y-axis robots has a Y-ballscrew structure that is formed directly on the component mounting apparatus chassis, for linearly thermally expanding and contracting only in the Y-axis direction with one end served as a fixed end and the other end served as a support end and moving the X-axis robot in the Y-axis direction, and the X-Y robot thermally expands and contracts linearly along the X-axis direction and the Y-axis direction.

27.(New) The component mounting apparatus as claimed in claim 26, wherein the X-axis robot comprises an X-frame that has both ends fixed to the ballscrew structure provided for each of the Y-axis robots and an

X-ballscrew structure which is formed on the X-frame, for thermally expanding and contracting linearly only in the X-axis direction with one end served as a fixed end and the other end served as a support end, receiving a component placing head provided with the component holding member, and moving the component placing head in the X-axis direction, and the X-Y robot having the X-axis robot thermally expands and contracts linearly along the X-axis direction and the Y-axis direction.

28.(New) The component mounting apparatus as claimed in claim 27, wherein the X-frame comprises: a support guide member that is attached to the X-frame along the X-axis direction, supporting the component placing head slidably in the X-axis direction and made of a material different from that of the X-frame; and a deformation prevention member, which is attached to the X-frame along the X-axis direction opposing the support guide member with interposition of the X-frame, for preventing the deformation of the X-frame, which is made of the same material as that of the support guide member.

29.(New) The component mounting apparatus as claimed in claim 28, wherein the component placing head comprises a plurality of the component holding members, a holding member-driving source for moving the

component holding members in a Z-axis direction perpendicular to the X-axis direction and the Y-axis direction, that is independently provided for each the component holding members to reduce generation of heat of the holding member- driving source.

30.(New) The component mounting apparatus as claimed in claim 25, wherein a plurality of the component recognition cameras are provided and the camera reference marks are provided adjacently to the respective component recognition cameras.

31.(New) The component mounting apparatus as claimed in claim 25, wherein the X-Y robot has a relative position immovable to the component holding member and the board recognition camera and thermally expands and contracts linearly along the X-axis direction and the Y-axis direction.

32.(New) The component mounting apparatus as claimed in claim 31, further comprising a component mounting apparatus chassis, wherein the component mounting apparatus chassis is formed into an integrated structure by casting and causes linear thermal expansion and contraction in the X-Y robot.

33.(New) The component mounting apparatus as claimed in claim 32, wherein the X-axis robot comprises an X-frame that has both ends fixed to the ballscrew structure provided for each of the Y-axis robots, the X-frame has a support guide member attached to the X-frame along the X-axis direction, and a deformation prevention member that is attached to the X-frame along the X-axis direction opposing the support guide member with interposition of the X-frame, for preventing the deformation of the X-frame due to heat, and the X-axis robot has a relative position immovable to the component holding member and the board recognition camera.

34.(New) The component mounting apparatus as claimed in claim 33, wherein the X-axis robot further comprises an X-ballscrew structure which is formed on the X-frame, for thermally expanding and contracting linearly only in the X-axis direction with one end served as a fixed end and the other end served as a support end, receiving a component placing head provided with the component holding member, and moving the component placing head in the X-axis direction, the component placing head comprises a plurality of the component holding members, a holding member-driving source for moving the component holding member in the Z-axis direction perpendicular to the X-axis direction and the Y-axis direction, that is independently provided for each the component holding members, and the

relative position of the component placing head is immovable to the component holding member and the board recognition camera.

35.(New) A component mounting method of carrying out by a component mounting apparatus with an X-Y robot having a component placing head provided with a component holding member for holding an electronic component to mount the electronic component held by the component holding member in a component placing position of a circuit board by moving the component placing head in an X-axis direction and a Y-axis direction that are perpendicular to each other, the method comprising:

image-picking up a camera reference mark, which is provided upright on a chassis individually of the X-Y robot and the component recognition camera, arranged adjacent to the component recognition camera for picking up an image of the electronic component held by the component holding member, arranged in a place where the image-pickup of the electronic component by means of the component recognition camera is not disturbed and provided at the same height position as a height position of the circuit board when the board recognition camera picks up an image of the board mark and an image-pickup height position of the component recognition camera by means of the board recognition camera that is provided for the

component placing head and image-picks up the board mark on the circuit board;

obtaining relative positional relations among the component holding member, the board recognition camera, and the component recognition camera from center position information of the component holding member obtained by image-picking up the component holding member by means of the component recognition camera and image-pickup information obtained by image-picking up an image-pickup mark provided at the image-pickup height position of the component recognition camera by means of the component recognition camera and the board recognition camera;

ignoring an amount of displacement of a positional relation between the component holding member and the board recognition camera among the relative positional relations with regard to an amount of displacement attributed to heat;

using the displacement information of the camera reference mark obtained by image-picking up the camera reference mark by means of the board recognition camera as information of a relative displacement between the board recognition camera and the component recognition camera; correcting the component placing position based on only the displacement information; and moving the electronic component to the placing position of the circuit board to place the electronic component.

36.(New) The component mounting method as claimed in claim 35, wherein, when productive mounting operation is interrupted, the image-picking-up of the camera reference mark is carried out immediately before restarting the productive mounting operation.

37.(New) The component mounting method as claimed in claim 35, wherein, when a difference obtained by comparing the position information of the camera reference mark obtained through the image-pickup with preset reference position information is not smaller than a set value, the operation of the component mounting apparatus is stopped.

38.(New) The component mounting method as claimed in claim 35, wherein a positional relation between the component holding member and the board recognition camera, a positional relation between the component holding member and the component recognition camera, and a positional relation between the board recognition camera and the component recognition camera are preliminarily measured, and the measurement values are treated as preconditions for the correction of the component placing position.

39.(New) The component mounting method as claimed in claim 35, wherein, when a plurality of the component recognition cameras are provided and a plurality of camera reference marks are provided and if the difference obtained by comparing the position information of the camera reference mark obtained by picking up an image of one of the plurality of the camera reference marks with the preset reference position information is smaller than a set value, then the image-pickup of the other camera reference marks is omitted.

40.(New) The component mounting method as claimed in claim 35 for placing the electronic component held by the component holding member of a component holding head movable with respect to a board holding device in the component placing position of the component mounting circuit board held by the board holding device, the method further comprising:

recognizing position coordinates of the placing region reference marks arranged at regular intervals on a placing region reference mark recognition reference board held by the board holding device in a state in which the placing region reference mark recognition reference board is held by the board holding device and positioned in the component placing region and then obtaining the position coordinate of each recognized placing region reference mark;

obtaining NC coordinates of the position coordinates of at least two board reference position calculation marks of the component mounting circuit board;

extracting placing region reference marks located near to the two board reference position calculation marks from among the recognized placing region reference marks;

obtaining an offset value of each placing region reference mark by subjecting the position coordinate of each extracted placing region reference mark to coordinate transformation so that a correction value of the extracted placing region reference mark becomes zero or substantially zero;

recognizing at least two board reference position calculation marks of the component mounting circuit board held by the board holding device in a state in which the component mounting circuit board is held by the board holding device and positioned in the component placing region in place of the placing region reference mark recognition reference board and then obtaining the position coordinates of the recognized two board reference position calculation marks;

correcting the NC coordinates of the two board reference position calculation marks based on the position coordinates of the obtained two board reference position calculation marks;

carrying out correction of the position coordinates of the component placing position based on the offset value of the placing region reference mark located nearest to the recognition camera provided for the component holding head when the component held by the component holding head is positioned above the component placing position of the component mounting circuit board; and thereafter placing the component in the component placing position based on the corrected position coordinates of the component placing position.

41.(New) The component mounting method as claimed in claim 40, wherein,

when obtaining the offset value of each placing region reference mark by subjecting the position coordinates of each extracted placing region reference mark to coordinate transformation so that the correction value of the extracted placing region reference mark located near to the two board reference position calculation marks becomes zero or substantially zero,

the offset values of placing region reference marks are obtained by subjecting the position coordinates of the extracted placing region reference marks to coordinate transformation, the coordinate transformation being carried out by rotating and shifting a graphic line that connects the extracted placing region reference marks so that each of the correction

values of the extracted placing region reference marks located near to the two board reference position calculation marks becomes zero or substantially zero, so that the positional coordinates of the extracted placement region reference mark is subjected to coordinate transformation.

42.(New) The component mounting method as claimed in claim 40, wherein,

when obtaining the offset value of each placing region reference mark by subjecting the position coordinate of each extracted placing region reference mark to coordinate transformation so that the correction value of the extracted placing region reference mark located near to the two board reference position calculation marks becomes zero or substantially zero,

the offset value of each placing region reference mark is obtained by calculating the correction value in at least one direction of the X-direction of the board holding device and the Y-direction perpendicular to the X-direction from the extracted placing region reference mark, obtaining an inclination of the reference board, and subjecting the position coordinate of each extracted placing region reference mark to coordinate transformation, the coordinate transformation being carried out so that the correction value of the extracted placing region reference mark becomes zero or substantially zero.

43.(New) The component mounting apparatus as claimed in claim 25 for placing the electronic component held by the component holding member of the component holding head movable with respect to the board holding device by means of the X-Y robot in the component placing position of the component mounting circuit board held by the board holding device, wherein

the board recognition camera is provided for the component holding head supported by the X-Y robot and recognizes the position coordinate of the placing region reference mark arranged at regular intervals on a placing region reference mark recognition reference board held by the board holding device in a state in which the placing region reference mark recognition reference board is held by the board holding device and positioned in the component placing region,

the apparatus further comprises an operation unit for: obtaining the position coordinate of each placing region reference mark from a recognition result of the placing region reference mark recognized by the board recognition camera; obtaining a difference between the NC coordinates and the position coordinates of the respective placing region reference marks as a correction value; extracting placing region reference marks located near to the two board reference position calculation marks from among the recognized placing region reference marks based on the NC coordinates of

the position coordinates of at least two board reference position calculation marks of the component mounting circuit board; obtaining an offset value of each placing region reference mark by subjecting the position coordinates of the extracted placing region reference mark to coordinate transformation so that the correction value of the extracted placing region reference mark becomes zero or substantially zero; recognizing at least two board reference position calculation marks of the component mounting circuit board held by the board holding device in a state in which the component mounting circuit board is held by the board holding device and positioned in the component placing region in place of the placing region reference mark recognition reference board; obtaining the position coordinates of the recognized two board reference position calculation marks; and correcting the NC coordinates of the two board reference position calculation marks based on the position coordinates of the obtained two board reference position calculation marks, and

the control unit corrects the position coordinates of the component placing position based on the offset value of the placing region reference mark located nearest to the recognition camera provided for the component holding head when the component held by the component placing head is positioned above each component placing position of the component mounting circuit board, and thereafter places the component in the

component placing position based on the corrected position coordinate of the component placing position.

44.(New) The component mounting apparatus as claimed in claim 43, wherein, when obtaining the offset value of each extracted placing region reference mark by subjecting the position coordinate of the extracted placing region reference mark to coordinate transformation so that each of the correction values of the extracted placing region reference marks located near to the two board reference position calculation marks becomes zero or substantially zero, the operation unit obtains the offset values of placing region reference marks by subjecting the position coordinate of the extracted placing region reference marks to coordinate transformation, the coordinate transformation being carried out by rotating and shifting a graphic line that connects the extracted placing region reference marks so that each of the correction values of the extracted placing region reference marks located near to the two board reference position calculation marks becomes zero or substantially zero.

45.(New) The component mounting apparatus as claimed in claim 43, wherein, when obtaining the offset value of each extracted placing region reference mark by subjecting the position coordinate of the extracted

placing region reference mark to coordinate transformation so that each of the correction values of the extracted placing region reference marks located near to the two board reference position calculation marks becomes zero or substantially zero, the operation unit obtains the correction value in at least one direction of the X-direction of the board holding device and the Y-direction perpendicular to the X-direction from the extracted placing region reference mark, obtains an inclination of the reference board, and obtains the offset value of each placing region reference mark by subjecting the position coordinate of the extracted placing region reference mark to coordinate transformation so that the correction value becomes zero or substantially zero.

46.(New) The component mounting apparatus as claimed in claim 43, comprising an X-Y robot that has two Y-axis robots arranged mutually parallel along the Y-axis direction and one X-axis robot that is arranged on the two Y-axis robots movably along the X-axis direction perpendicular to the Y-axis direction and movably supports the component holding head along the X-axis direction, wherein the component holding head is made movable by the two Y-axis robots and the one X-axis robot in the X- and Y-axis directions with respect to the board holding device.

47.(New) The component mounting apparatus as claimed in claim 46, wherein the component holding head has a plurality of component suction nozzles that are each able to suck and hold the component and that are arranged along the X-axis direction, and the board recognition camera is arranged on the component holding head so that an image-pickup center of the board recognition camera is positioned coaxially with a straight line that extends through a center of the plurality of component suction nozzles.